Active Project (2014 - 2016)

Implementation & Flight Testing of IMPACT system for Autonomous ISR using Collaborating UAVs with Application to Wild Fire Monitoring Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

ABSTRACT

SSCI and MIT propose to further develop, implement and test the Integrated Mission Planning & Autonomous Control Technology (IMPACT) system software for autonomous ISR missions employing collaborating UAVs. IMPACT system is based on real-time learning about dynamic and stochastic environments, and on a capability to autonomously react to contingencies while satisfying the mission objectives and the overall flight safety. Phase II focus will be on real-time vehicle assignment & trajectory planning technologies for forest fire monitoring, overall system integration, and evaluation of its performance through computer and hardware-in-the-loop simulations and flight tests at Olin College or Great Dismal Swamp. Key technologies to be further developed & tested in Phase II include: (i) Vehicle assignment & real time trajectory generation for collaborative ISR for fire boundary identification using the MOTOR system (Multi-objective Trajectory Optimization & Re-planning); (ii) Robust on-line learning for prediction of the fire spread using the intelligent Cooperative Control Architecture (iCCA); (iii) Collaborative assignment for fire perimeter tracking with reactive trajectory planning based on predicted fire spread using MOTOR and iCCA; (iv) Contingency management, including the loss of vehicle, vehicle replacement & mitigation of lost communication link; and (v) Predictive camera pointing control based on predicted fire spread. The project will leverage a number of technologies recently developed by SSCI and MIT, and integrate various system modules within a flexible and user-friendly software product. Phase II deliverables will include the IMPACT software and accompanying documentation, while Phase III will be focused on commercialization of the IMPACT software.

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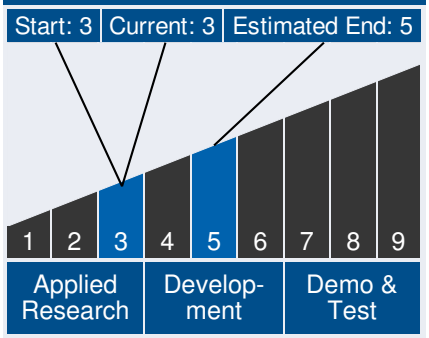
Technology Maturity



Management Team

Program Executive:

- Joseph Grant

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ANTICIPATED BENEFITS

To NASA funded missions:

Autonomous ISR & science missions employing collaborating UAVs offer great potential for improving the productivity of NASA airborne science research. The related autonomous missions will include high altitude atmospheric composition measurements of specific chemical or physical conditions that contribute to climate change. A mission in which the instrument measurements guide the flight path requires real-time analysis and a high degree of autonomy. Other relevant missions include detection and monitoring of hurricanes, oil spills and wildfires, and communication of the location and imagery to the control centers and crews on the ground. In fire monitoring, the sensor system must be automated to search for fires in designated areas, revise plans when fire detection task takes longer than expected, track satellite passes to ensure transmission of data, and monitor fuel state to ensure safe return of the vehicle. Fully autonomous UAVs, capable of performing such missions, are envisioned as a part of future NASA's Sensorweb - a networked set of instruments in which information from one sensor is automatically used to redirect or reconfigure other components of the web.

To the commercial space industry:

UAVs have a variety of applications for US Homeland Security. The US Customs and Border Protection (CBP) Border Patrol tested UAVs in its Arizona Border Patrol Initiative, aimed at minimizing illegal and dangerous border crossings. According to the CBP, the advantages of UAVs include advanced image recognition systems in both day and night-time monitoring, longer dwell time (in comparison to manned Black Hawk helicopters) resulting in more sustained coverage, decreased need for human resources and the ability to work in dangerous conditions, resulting in increased safety for ground agents. In addition to border patrol, UAVs have application in search and

Management Team *(cont.)*

Program Manager:
- Gary Jahns

Project Manager:
- Kimberly Graupner

Principal Investigator:
- Jovan Boskovic

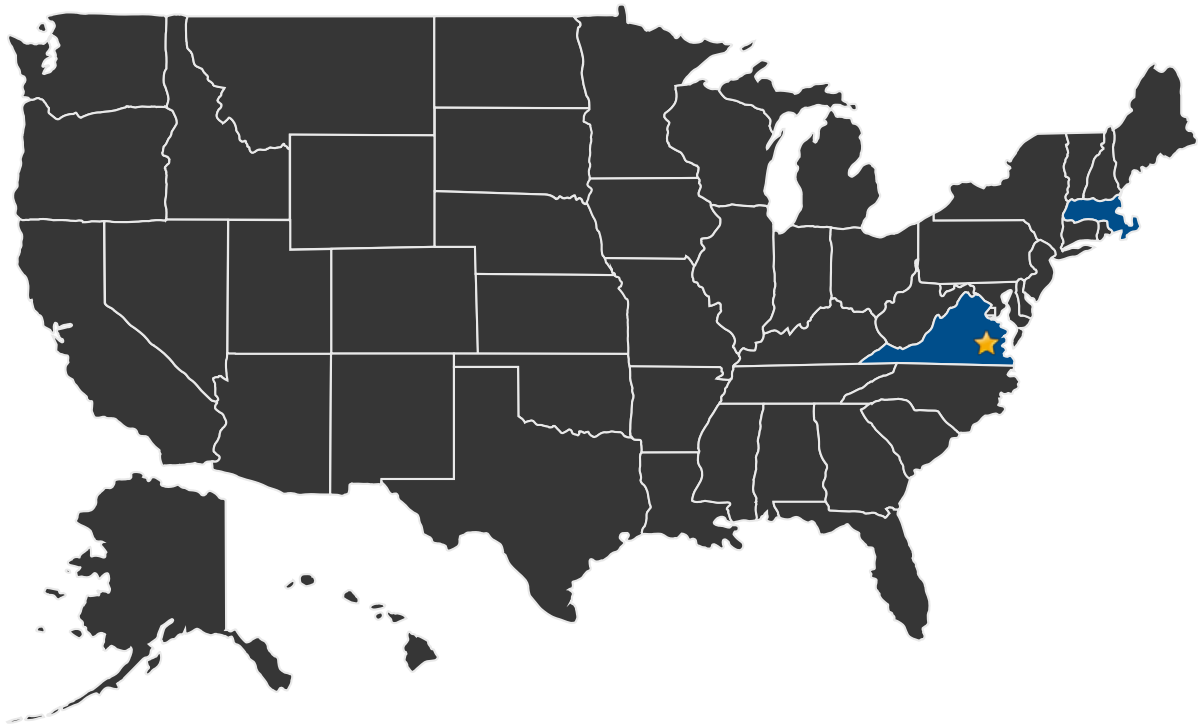
Technology Areas

Primary Technology Area:
Multi-Agent Coordination (TA 4.5.4.1)

Secondary Technology Area:
Communications, Navigation, and Orbital Debris Tracking and Characterization Systems (TA 5)
└ Cognitive Networks (TA 5.5.3)

rescue; monitoring of hurricanes, floods and mud slides; maritime, harbor and littoral patrol and monitoring critical infrastructure such as dams and aqueducts; energy and water pipelines; and assets in the national power grid, which may span many miles and require long, tedious but essential monitoring. There is also a great potential for autonomous UAVs in a variety of agricultural and military applications.

U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Langley Research Center

Other Organizations Performing Work:

- Massachusetts Institute of Technology
- Scientific Systems Company, Inc. (Woburn, MA)

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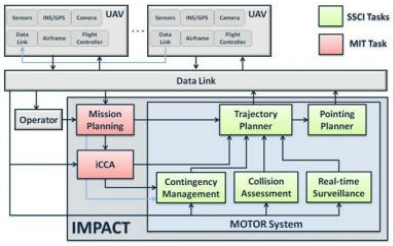
IMAGE GALLERY



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DETAILS FOR TECHNOLOGY 1

Technology Title

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